Comparison of two evaluation methods for feet and leg conformation traits at 100 days of age in replacement gilts

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Summary

Replacement gilt feet and leg conformation traits were evaluated using subjective and objective evaluation techniques at 100-d of age to determine the association between the two methods. Crossbred Large White × Landrace gilts (n = 641) were used for this study. Gilts (n = 72) were moved on a weekly basis for 9 weeks to a development unit at 77-d of age. Within each group, 24 gilts were randomly allotted to 3 pens such that littersmates and gilts originating from the same parity sows were distributed evenly among pens. At approximately 100-d of age, gilts were weighed and front and rear legs and pasterns were subjectively scored using a five-point scale. Due to low frequency of subjective scores one and five, values were re-classified as ≤2, 3 and ≥4. Additionally, joint angles were measured for the knee, front and rear pasterns and hock using objective methodology. Association was evaluated between corresponding subjective and objective evaluation scores using a Mann-Whitney U-test. The majority of gilts received score 3 during the subjective scoring for the front and rear leg angulations (86% and 76% of gilts, respectively) and for the front pasterns (85%). For the rear pasterns, 56% of gilts received score 3 and 40% received score 4. Mean angles for the knee, front and rear pasterns and hock were 157.6 ± 6.1, 51.5 ± 6.7, 55.5 ± 6.15 and 137.9 ± 6.9, respectively. An association between both evaluation methods was observed for the front and rear pasterns (P < 0.05) and a tendency of association was observed between evaluation methods for front leg angulation and knee joint angle (P = 0.06) and for rear leg angulation and hock joint angle (P = 0.06). From the generalized linear model, knee joint angles tended (P = 0.06) to be 2 degrees less in gilts receiving scores ≤2 for front leg angulation when compared with gilts receiving higher scores. Front pastern and hock joint angles were 4 and 2 degrees greater (P < 0.05) in gilts receiving a score ≥4 for front pastern and rear leg angulation when compared with gilts receiving lower scores. Rear pastern joint angles were 3 degrees less (P < 0.05) in gilts receiving scores 3 for rear pasterns when compared with gilts receiving other scores. Association between the scoring methods shows that the scoring systems are comparable. However, greater variation amongst objective measures is potentially more beneficial in identifying structural deficiencies earlier in life as opposed to subjective measures, as the variation could be exploited in an effective selection program.

Keywords: replacement gilts, feet, legs, selection, swine

Introduction

Subjective scoring of feet and leg conformation traits is commonly used when evaluating breeding herd replacement gilts for the swine herd. However, subjective methods depend on training received by the scorers and thus, their intra-scorer and inter-scorer repeatability can
vary (Main et al., 2000; D’Eath, 2012). Although scorer training, retraining and experience can substantially improve repeatability. However, feet and leg evaluation accuracy can be diminished by multiple factors within each organization, such as staff turnover or trainer availability. An objective evaluation method (Stock et al., 2017) has been developed as an alternative scoring system when evaluating breeding herd feet and leg conformation for replacement gilts. While the objective method has been shown to be repeatable, the evaluation has not been compared to the subjective system when evaluating the same animals. The objective of this study was to identify the associations between subjective and objective feet and leg conformation scoring systems to evaluate breeding herd replacement gilts when evaluating the same animals.

Material and Methods

This study was approved by the Institutional Animal Care and Use Committee of the USDA Meat Animal Research Center (Clay Center, Nebraska), study #28.1. Crossbred Large White × Landrace gilts (n = 641), were used for this study. The study was conducted at the Smithfield Production facilities near Milford, Utah. Gilts (n = 72) were moved on a weekly basis for 9 weeks to the gilt development unit at 77 days of age. Within each weekly group, 24 gilts were randomly allotted to three pens such that littermates and gilts originating from the same parity sows were distributed evenly among pens. At approximately 100-d of age, gilts were weighed and angulation of front and rear legs and front and rear pasterns were scored using subjective and objective methods.

Subjective scoring method

A modified version of the scoring system developed by Fan et al. (2009) was used for this study. Front and rear legs and pasterns were scored using a 5-point scale. Gilts were scored by 3 trained observers, however, within each group only one scorer did the evaluation. The observers were trained to use the scoring system by an experienced researcher. A score of one for front leg angulation represented a normal knee set, whereas a score of five represented a severe buck knee. A rear leg angulation score of one represented a weak or sickle-hocked rear leg, a score of three represented a normal hock set, and a score of five represented an upright or straight rear leg. Pasterns were scored the same for both front and rear, where a score of one represented a weak/soft pastern, a score of three represented an intermediate angulation and a score of five represented an upright or straight pastern.

Image collection and objective evaluation scoring method

Gilts’ feet and leg image collection and image processing followed a similar procedure to those described by Stock et al. (2017). A digital video recorder was used to capture digital video images. Videos were reviewed to be sure the animal was in the correct standing position and then individual digital image frames were extracted from the videos using Free Video to JPG Converter (Digital Wave, Ltd., United Kingdom, https://www.dvdeosoft.com). Multiple frames were captured from each video. Further information regarding image selection and quality can be found in previous work reported by Stock et al. (2017). Angles for the knee, front and rear pasterns and hock were measured.

Statistical analysis
All analyses were conducted using SAS v9.4 (SAS Inst. Cary, NC) software. Due to low frequency of subjective scores one and five in the subjective method, values were reclassified as ≤2, 3 and ≥4. Association between subjective and objective methods was evaluated using a Mann-Whitney U-test in PROC NPAR1WAY. A generalized linear model was fit with corresponding subjective scores and contemporary group as fixed effects, and weight as a linear covariate, to obtain mean joint angle values per subjective score.

Results & Discussion

Feet and leg conformation of replacement gilts is currently measured using subjective methods based on visual observation and categorical associations. However, the reliability of such methods depends on the training and experience of the observers. In the present study, due to management practices, three scorers were needed to carry out the subjective score, highlighting the need to move towards an objective evaluation method. In subjective methods, extreme scores usually represent extreme phenotypes that are not commonly observed. In this study, most gilts received the middle score (i.e. score 3) during the subjective scoring for the front and rear leg angulations (86% and 76% of gilts, respectively) and for the front pasterns (85%). For the rear pasterns, 56% of gilts received a score of 3 and 40% received a score of 4. Number and percentage of gilts by score category by trait evaluated are presented in Table 1.

<table>
<thead>
<tr>
<th>Trait</th>
<th>Score ≤ 2</th>
<th>Score 3</th>
<th>Score ≥ 4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>n</td>
<td>%</td>
<td>n</td>
</tr>
<tr>
<td>Front Leg Angulation</td>
<td>51</td>
<td>8.0</td>
<td>554</td>
</tr>
<tr>
<td>Rear Leg Angulation</td>
<td>58</td>
<td>9.0</td>
<td>489</td>
</tr>
<tr>
<td>Front Pastern Angulation</td>
<td>16</td>
<td>2.5</td>
<td>545</td>
</tr>
<tr>
<td>Rear Pastern Angulation</td>
<td>27</td>
<td>4.2</td>
<td>359</td>
</tr>
</tbody>
</table>

*A modified version of the scoring system developed by Fan et al. (2009) was used in this study.*

Technological advances in computer software and digital imagery provide a new opportunity to researchers, as well as the industry, to expand the research that has been done to date and potentially minimize the need for extensive training and experience and reduce potential risks with subjective methods. We developed a repeatable objective evaluation method for feet and leg conformation traits of replacement gilts (for more details please see Stock et al., 2017), allowing us to accurately measure joint angulation. In this study, mean joint angles for the knee, front and rear pasterns and hock were 157.6 ± 6.1 degrees, 51.5 ± 6.7 degrees, 55.5 ± 6.2 degrees and 137.9 ± 6.9 degrees, respectively. These joint angles are mostly in agreement with those previously reported by Stock et al. (2017).

An association between both evaluation methods was observed for the front and rear pasterns ($P < 0.05$) and a tendency to be associated was observed between evaluation methods for front leg angulation and knee joint angle ($P = 0.06$) and for rear leg angulation and hock joint angle ($P = 0.06$). Knee joint angles tended ($P = 0.06$) to be 2 degrees less in gilts receiving scores ≤2 for front leg angulation compared with gilts receiving higher scores (Table 2). Front pastern and hock joint angles were 4 degrees and 2 degrees greater ($P < 0.05$)
in gilts receiving a score ≥4 for front pastern and rear leg angulation compared with gilts receiving lower scores. Finally, rear pastern joint angles were 3 degrees less \( (P < 0.05) \) in gilts receiving scores 3 for rear pasterns compared with gilts receiving other scores (Table 2).

Table 2. Mean joint angles \((\text{mean} \pm \text{SD})\) for knee, front and rear pasterns and hock by subjective visual score category\(^1\) of 100-d old replacement gilts

<table>
<thead>
<tr>
<th>Trait</th>
<th>Score ≤ 2</th>
<th></th>
<th></th>
<th>Score ≥ 4</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LSMeans</td>
<td>SE</td>
<td>LSMeans</td>
<td>SE</td>
<td>LSMeans</td>
</tr>
<tr>
<td>Knee</td>
<td>155.9(^a)</td>
<td>0.9</td>
<td>157.7(^b)</td>
<td>0.25</td>
<td>158.3(^{a,b})</td>
</tr>
<tr>
<td>Front Pastern</td>
<td>51.0(^a)</td>
<td>1.6</td>
<td>51.0(^a)</td>
<td>0.3</td>
<td>56.0(^b)</td>
</tr>
<tr>
<td>Rear Pastern</td>
<td>55.1(^{a,b})</td>
<td>1.2</td>
<td>54.2(^a)</td>
<td>0.3</td>
<td>57.6(^b)</td>
</tr>
<tr>
<td>Hock</td>
<td>136.2(^a)</td>
<td>0.9</td>
<td>137.8(^a)</td>
<td>0.3</td>
<td>139.5(^b)</td>
</tr>
</tbody>
</table>

\(^1\)Values in degrees.

\(^2\)Subjective scores of 1 and 2, and 4 and 5 were consolidated into 1 category due to low frequency of scores 1 and 5.

\(^{a,b}\)Within rows, significant differences between predictor variables \((P < 0.05)\).

In conclusion, associations between the subjective and objective scores were observed in the present study, however, greater variation amongst groups within the objective measures could be more beneficial in identifying structural deficiencies as opposed to subjective measures. The larger variation could be exploited in an effective selection program to improve longevity, based on the association between the traits of interest in this study and sow longevity (Stalder et al., 2004).

Acknowledgements

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List of References


